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# The use of performance-enhancing substances (doping) by athletes in Saudi Arabia

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## Abstract:

**BACKGROUND:** Data on doping violation in Saudi Arabia are scarce. Our aim was to investigate the Saudi experience of anti-doping and review all positive samples and adverse analytical findings (AAFs) of Saudi athletes.

**MATERIALS AND METHODS:** This study analyzed databases of the Saudi Arabian Anti-Doping Committee from 2008 to May 2016. The samples originated from various sporting events and were collected in and outside sport competitions. The substances investigated were those included in the annual lists of prohibited substances produced by the World Anti-Doping Agency (WADA). All urine samples were tested in laboratories accredited by the WADA. Samples were declared positive if they contained any prohibited substance on the WADA list for that year.

**RESULTS:** In 4482 urine samples tested, 141 positive samples (3.1%) and 195 AAFs of prohibited substances were detected. The prevalence of positive samples was highest in 2012 (6.6%) and lowest in 2015 (1%). The most prevalent prohibited substances detected were anabolic steroids (32.8%) and stimulants (27.6%). The most frequently detected compounds were amphetamines (22%) and tetrahydrocannabinol (12.8%). The highest prevalence of AAFs was in bodybuilders.

**CONCLUSION:** The prevalence of doping in Saudi Arabia seems to be higher than western countries, but this needs to be confirmed with further research.

## Keywords:

Doping, performance-enhancing substances, WADA, Saudi Arabia

## Introduction

The use of illegal substances to enhance performance is not new among athletes. This has occurred from the time of the Ancient Greeks to the present days and has been reported in many professional athletes.<sup>[1]</sup> The use of these illegal substances may have serious health effects including dependency and death. The World Anti-Doping Agency (WADA) was established in 1999 by the International Olympic Committee to counter such untoward behavior among athletes in sporting competitions. The WADA assumed responsibility for anti-doping from the International Olympic Committee

with the main objective of regulating, promoting, coordinating, and controlling doping worldwide and monitoring the World Anti-Doping Code. The code is the document which harmonizes regulations on anti-doping in all sports in all countries. The aims of the World Anti-Doping Code are to care for the athlete's fundamental right to participate in doping-free sport; promote health, fairness, and equality for athletes worldwide; and guarantee harmonized, coordinated, and effective anti-doping programs at the international and national level relating to the detection and prevention of doping.<sup>[2]</sup>

The WADA also produces a prohibited list of banned substances that is updated annually and documents the prohibited substances

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and methods of use during and outside competitions. Currently, two of the following three criteria must be met for a substance or a method to be included on the prohibited list: (1) The substance increases or has the potential to increase performance; (2) the substance represents an actual or potential health risk to the athlete; and (3) the substance violates the spirit of sport.<sup>[3]</sup>

Urine is the biological specimen most frequently used for anti-doping testing. Urine samples are screened for all substances included on the prohibited list. The prohibited list is revised annually according to the growing knowledge of illegal sport-enhancing practices.<sup>[4]</sup>

The Saudi Arabian Anti-Doping Committee (SAADC) was established to act as the independent national anti-doping organization for Saudi Arabia. The SAADC plans, coordinates, implements, monitors, and advocates improvements in doping control in Saudi Arabia. The SAADC also vigorously pursues all potential anti-doping rule violations; plans and implements anti-doping information, education, and prevention programs; and promotes anti-doping research.<sup>[5]</sup>

The data on the prevalence and scope of doping violation in Saudi Arabia, types of substances usually used, and sports associated with the highest frequency of doping are inadequate. The purpose of the present paper was to investigate anti-doping in Saudi Arabia by reviewing databases of urine samples of Saudi athletes; all the data of adverse analytical findings (AAFs) and the types of performance-enhancing substances that have been used since the establishment of the SAADC until May 2016.

## Materials and Methods

The samples obtained from various sporting events conducted in different regions in Saudi Arabia collected in and outside (during training or camps or in the athletes' accommodation) sporting competitions from 2008 to May 2016. All samples were from male athletes. The samples were confidential and coded without names before delivery to the accredited laboratories. The substances investigated varied according to the annual prohibited lists produced by the WADA. All urine samples were sent to laboratories accredited by the WADA according to the International Standard for Laboratories to ensure that the laboratories produced valid test results and evidence-based data to achieve uniform and harmonized results from all laboratories. Samples were declared positive if they contained any prohibited substance on the WADA list in effect that year.<sup>[6]</sup>

Mass spectrometry coupled with gas or liquid chromatography was the analytical technique of choice

for confirmation of prohibited substances, metabolites of prohibited substances, or markers of the use of a prohibited substance or prohibited method. This method was used for both initial testing procedures and confirmation procedures for a specific analyte. Affinity binding assays (immunoassays) were routinely used for the detection of macromolecules in urine samples using affinity reagents (antibodies) that recognized different epitopes of the macromolecule analyzed, unless a purification or separation method was used before the application of the affinity binding assay to eliminate cross-reactivity. In assays which included multiple affinity reagents such as sandwich immunoassays, only one affinity reagent (either applied for capture or detection of the target analyte) used in the affinity binding assays that was applied for the initial testing procedures and confirmation procedures differed for antigenic epitope specificity. The other affinity reagent was used in both immunoassays. For analytes that were too small to have two independent antigenic epitopes, two different purification or analytical methods were applied. When >1 prohibited substance, metabolite of a prohibited substance, or marker of the use of a prohibited substance or prohibited method was identified by the initial testing procedure, the laboratory confirmed as many of the presumptive AAFs as possible. For threshold substances, AAF or atypical finding decisions were based on the mean of the measured concentrations or ratio calculated from the means of measured concentrations, chromatogram peak heights, or areas of three aliquots; this value exceeded the value of the relevant decision limit as specified in the technical document on decision limits or applicable guidelines.<sup>[6]</sup> Descriptive analysis was performed and data presented in the form of frequencies and percentages.

This study was approved by the Ethical Review Committee of King Abdulaziz Medical City, Riyadh, Saudi Arabia.

## Results

A total of 4482 urine samples from athletes in Saudi Arabia from 2008 to May 2016 were tested [Table 1]. Of all the urine samples tested, 254 were from non-Saudi athletes. Of all the samples, 3496 (78%) were collected in competitions, and 986 (22%) collected outside sporting competitions. A total of 141 positive samples were detected, out of which 130 were during competitions and 11 outside competitions. In the 141 positive samples, 195 AAFs of prohibited substances were detected because some positive urine samples contained >1 prohibited substance [Table 1]. Of the positive samples, six were from non-Saudi athletes. The prevalence of positive urine samples obtained from 2008 to May 2016 in athletes in Saudi Arabia was 3.1%. The prevalence was highest in 2012 (6.6%) and lowest in 2015 (1%) [Table 1].

**Table 1: Distribution of tested urine samples and types and numbers of adverse analytical findings conducted by the Saudi Arabia Anti-Doping Committee, 2008 to May 2016**

Results	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)	2016 (%)	Total N (%)
Total urine samples tested	81	149	371	385	480	495	910	1007	604	4482
Positive samples [N (%)]	5 (6.1)	7 (4.7)	18 (4.8)	12 (3.1)	32 (6.6)	27 (5.4)	19 (2)	10 (1)	11 (1.8)	141 (3.1)*
Anabolic steroids <sup>a</sup>	3	4	6	1	29	9	5	5	2	64 (32.8) <sup>†</sup>
Stimulants <sup>b</sup>	0	1	8	4	6	11	9	6	9	54 (27.6) <sup>†</sup>
Cannabis <sup>c</sup>	0	1	6	2	5	8	2	1	0	25 (12.8) <sup>†</sup>
Beta agonists <sup>d</sup>	2	1	1	1	10	0	2	0	0	17 (8.7) <sup>†</sup>
Diuretics <sup>e</sup>	0	0	1	1	0	1	2	0	0	5 (2.5) <sup>†</sup>
Glue sniffing <sup>f</sup>	0	0	0	3	4	2	1	0	0	10 (5.1) <sup>†</sup>
Other substances <sup>g</sup>	0	4	0	0	11	0	1	3	1	20 (10.3) <sup>†</sup>
Adverse analytical findings	5	11	22	12	65	31	22	15	12	195

\*Total number and percentage of the positive urine samples, <sup>†</sup>Total number and percentage of adverse analytical findings for different prohibited substances, <sup>a</sup>Anabolic steroids = Methandienone, stanozolol, 19-norandrosterone, boldenone, bandrolone, methenolone, drostanolone, 17-alpha-trenbolone, mesterolone, prednisolone, betamethasone, epimethandiol, <sup>b</sup>Stimulants = Ephedrine, amphetamine, methylhexanamine, D-methamphetamine, isometheptene, <sup>c</sup>Cannabis = Tetrahydrocannabinol, <sup>d</sup>Beta agonists = Clenbuterol, <sup>e</sup>Diuretics = Furosemide, <sup>f</sup>Glue sniffing = 4-methyl-2-hexanone, <sup>g</sup>Other substances = Tamoxifen, hCG, isometheptene (sympathomimetic). hCG = Human chorionic gonadotropin

The most prevalent prohibited substances detected in the urine of athletes in Saudi Arabia were anabolic steroids (64 of 195 AAFs [32.8%]) and stimulants (54 of 195 AAFs [27.6%]). The most frequently detected compound was amphetamine (43 of 195 AAFs [22%]) and tetrahydrocannabinol (25 of 195 AAFs [12.8%]).

Most AAFs for anabolic steroids were for boldenone, 19-norandrosterone, and stanozolol. Most stimulants detected were amphetamines. A peak of positive results for all prohibited substances was observed in 2012, with 32 positive samples (6.6%) and 65 AAFs due to the highest AAFs for anabolic steroids and beta agonists.

With respect to the prevalence of positive results in particular sports, the highest prevalence was observed in bodybuilders (22 positives out of 32 tests - 69%), track and field athletes, and football players [Table 2]. Amphetamine was the most frequently detected compound in track and field athletes, football players, weightlifters, basketball players, and handball players.

## Discussion

This work was an analytical investigation of the data collected by the SAADC on 4482 urine samples from Saudi athletes from 2008 to May 2016. The prevalence of positive samples in athletes in Saudi Arabia was 3.1%. The most prevalent prohibited substances used were anabolic steroids and stimulants. Of all substances used, the most frequently detected compounds were amphetamine and tetrahydrocannabinol. The highest prevalence of AAFs was observed in bodybuilders, track and field athletes, and football players. The data reflect the work done by the SAADC since its establishment and its effort to prevent and detect doping violations in Saudi Arabia. It is important that these data are released to estimate the magnitude of the problem and

**Table 2: Sports with highest number of positive samples detected among all sports subjected to anti-doping testing in Saudi Arabia, 2008 to May 2016**

Sport	Total number of urine samples	Positive results	Adverse analytical findings	Most common substance detected
Bodybuilding	32	22	54	Boldenone
Track and field	517	27	20	Amphetamine
Football	1850	21	23	Amphetamine
Weightlifting	252	12	22	Methandienone
Basketball	174	8	12	Amphetamine
Handball	209	11	11	Amphetamine
Judo	103	5	7	Furosemide
All other types of sport*	1345	35	46	
Total	4482	141	195	

\*Volleyball, table tennis, karate, swimming, tennis, taekwondo, squash, gymnastics, cycle, wrestling, water polo, boxing, duel, special needs, archery, and shooting

plan future prevention and deterrents of violations in sport. Since such data had not previously been reported in our region, there is a gap in the research that deals with doping violations in the Arab world. These data are absent because all regional anti-doping committees are new and have little experience on doping. Besides, research has not been a priority. In another study, we reported 4.3% prevalence rate of using prohibited substances (doping) among 1142 Saudi male sportsmen. The main reason for using prohibited substances was to improve performance (69%). The prevalence of using food supplements (not prohibited) was 38.4%. Thirty percent of the players believed that such behavior was against the spirit of sport while 70% of the players were aware of punishment against doping. Sixty-five percentage of players admitted that they had had advice on prohibited substances. The higher rate of the use of prohibited substances by Saudi players was associated with low education, age below 20 years, previous

use of food supplements, and lack of awareness of punishment.<sup>[7]</sup>

The results of another preliminary study that addresses the use of dietary supplements by 105 football players in Riyadh showed that 93.3% athletes used different dietary supplements throughout the season. Forty-three percent of athletes reported using supplements for performance, and 32% athletes believed that there were health benefits for using dietary supplements.<sup>[8]</sup>

There are not enough data to estimate the number of adult athletes who intentionally use performance-enhancing substances in Saudi Arabia and the Arab region. However, sport federations and authorities and experts have reported many cases on multiple occasions, and it is believed that doping and drug abuse are common with Saudi adult athletes. Without availability of a study that investigate the use of performance-enhancing substances in the general population in our country, it is impossible to conclude that the use of performance-enhancing substances is more common in Saudi athletes than in the general population. The prevalence is much higher in the present study than in a study from Italy. Data obtained from anti-doping analyses of 100,000 urine samples from 2000 to 2009 in Italy showed the frequency of AAFs as 1.0%–1.8%.<sup>[4]</sup> However, a comparison should be interpreted with caution because of the larger number of urine samples in the Italian study. In a survey of 1459 athletes done in France, 4% of the athletes stated that they had used performance-enhancing agents at least once in their life.<sup>[9]</sup> In another study that used analytical chemistry to determine the prevalence of drug abuse among elite sports students, the prevalence of positive urine samples was 11%, and the most frequently detected compounds were the major metabolites of tetrahydrocannabinol (9.8%) and various stimulants related to amphetamine and cocaine (1.0%).<sup>[10]</sup> Despite these reports, the true prevalence of doping worldwide in elite sports is unknown. A combination of questionnaires using randomized response techniques and models of biological parameters suggests that the current prevalence of intentional doping in elite athletes is between 14% and 39%. This range varies with subgroups based on the type of sport. The estimated doping control test results suggest a frequency of 1%–2% annually.<sup>[11]</sup>

According to the standard regulations of the WADA, most urine samples in the present study were collected randomly, but some were collected intentionally. Therefore, the distribution of the tested urine samples from 2008 to 2016 was not homogeneous, which reflects the inexperience of the SAADC; this sampling started in the 1<sup>st</sup> year of the establishment of the SAADC as a separate entity responsible for detecting anti-doping violations in Saudi Arabia. The number of urine samples

collected per year may depend on many factors including human resources, financial support, time constraints, importance of the competition, and other logistics.

The annual positive results reported in this study ranged between 1% and 6.6%, with a high proportion of anabolic steroids and stimulants [Table 1]. Androgenic-anabolic steroids are known for their effect of increasing muscle mass and strength. The highest positive results were reported in bodybuilding sports (22 of 32 samples), in which the most common substance was boldenone. Boldenone, an animal anabolic steroid, is a nonprescription drug for humans in Saudi Arabia.<sup>[12]</sup> Most of the analytical finding substances are sold illegally in Saudi Arabia, and their doses and purity are questionable. The high prevalence of the use of stimulants and cannabis by Saudi athletes suggests that the intake of these substances is more likely to be recreational rather than intention to cheat in sport; these substances may be used recreationally because of habitual drug use not linked to sporting activities. The highest prevalence of AAFs was found in bodybuilders, track and field athletes, and football players, but this may not be accurate because the distribution of sampling was not homogenous in all types of sports and athletes.

Although this research has increased the data available in this field, provided general insights, and identified trends on doping violations in our region, it has several limitations which should be taken into account in interpreting the results. The study was a database review for AAFs of urine samples of Saudi athletes done in laboratories accredited by the WADA; however, chemical analysis cannot detect all doping substances in urine, and there is a high probability that some positive samples were missed. Moreover, our data did not include other violations such as refusal of testing and blood test results. The data were limited to male athletes because, during the sample collection period, there were no formal Saudi females' athletes to be tested. The number of urine samples was smaller in the present study than in studies in Western countries, mainly because of the smaller number of national athletes and competitions and the relatively new anti-doping committee in Saudi Arabia.

## Conclusion

The present study confirmed that doping is a common problem in Saudi Arabia and an improvement should be made in anti-doping screening and education to ensure a safe and fair sporting environment for Saudi Arabian athletes.

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## Conflicts of interest

There are no conflicts of interest.

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